REMARKS

Review and reconsideration on the merits are requested.

Basis for Claim Amendments

Claim 1

In the amended claim 1:

"A graphite-containing heat-resistant cast iron comprising Si and W, and having intermediate layers, in which W and Si are concentrated, in the boundaries of graphite particles and a matrix," finds support at page 9, lines 24-27 in paragraph [0025] of the specification;

"wherein said graphite-containing heat-resistant cast iron comprises 3.5-56% of Si and 1.2-15% of W on a weight basis," finds support at page 9, lines 21-22 in paragraph [0024] of the specification;

"wherein a ratio (Xi/Xm) of a weight ratio Xi of W in said intermediate layers to a weight ratio Xm of W in said matrix is 5 or more and a ratio (Yi/Ym) of a weight ratio Yi of Si in said intermediate layers to a weight ratio Ym of Si in said matrix is 1.5 or more," finds support at page 10, lines 3-9 in paragraph [0026] of the specification; and

"said heat-resistant cast iron having a composition comprising, on a weight basis, 1.5-4.5% of C, 3.5-5.6% of Si, 3% or less of Mn, 1.2-15% of W, less than 0.5% of Ni, 0.3% or less of Cr, and 1.0% or less of a graphite-spheroidizing element, the balance being substantially Fe and inevitable impurities,

said graphite-spheroidizing element comprising 0.003-0.02% by weight of S and 0.05% or less by weight of a rare earth element in addition to 0.005-0.2% by weight of Mg" finds support at page 11 lines 17-21 in paragraph [0032], and page 12, lines 2-3 in paragraph [0034] with page 21, line 20 to page 22, line 5 in paragraphs [0089] and [0090] of the specification.

With the amendments to claim 1, claims 2-6 are canceled.

Claim 13

In amended claim 13, --wherein with respect to W-containing carbide particles on the surface of graphite particles exposed by etching, their number is 3 x $10^5/mm^2$ or more and/or their area ratio is 1,8% or more, per a unit area of graphite-- finds support at page 10, line 24 to page 11, line 3 in paragraph [0030] of the specification.

Claim 19

With the amendments of claim 1, claim 19 is changed from an independent claim to a dependent claim, dependent from amended claim 1.

The preamble part thereof is changed from "An exhaust equipment member used at temperatures exceeding 800°C, which is formed by a heat-resistant cast iron having a composition comprising, on a weight basis, L5-4.5% of C, 3.5-5.6% of Si, 3% or less of Mn, 1.2-15% of W, less than 0.5% of Ni, 0.3% or less of Cr, and 1.0% or less of a graphite-spheroidizing element, Si + (2/7) W ≤ 8, and the balance being substantially Fe and inevitable impurities," to --The exhaust equipment member used at temperatures exceeding 800°C, which is formed by a graphite-containing heat-resistant cast iron of claim 1, wherein Si and W meet the condition of Si + (2/7) W ≤ 8 on a weight basis,--

In amended claim 19, --wherein Si and W meet the condition of Si + (2/7) W ≤ 8 on a weight basis-- finds support at page 10, lines 12-13 in paragraph [0028] of the specification.

With the amendments of claim 19, claims 20 and 22 are canceled.

Miscellaneous

The dependency of claims 21 and 23 is changed from claim 19 (in light of the cancellation of claim 20) to claim 1.

The Prior Art

JP 61-157655 (JP -655 or JP '655); German Patent DE 2,428,821 (DE -821 or DE '821); admitted prior art in paragraph [0003].

Applicants treat the rejections in the order posed.

Unless necessary to an understanding of Applicants' traversal of any particular rejection, the Examiner's remarks will not be repeated in this amendment.

Rejection of Paragraph 2

Claims 1-3, 5, and 7-16 are rejected under 35 U.S.C. § 102(b) as anticipated by JP -655 or DE -821.

This rejection is respectfully traversed.

Traversal

The Examiner states in Paragraph 3 of the Action:

"JP-655 and DE-821, each disclose specific graphitic cast iron alloys that meet the claimed composition and satisfy the claimed equation Si + (2/7)W $\leq$ 8 See JP-655, examples 4 and 7 on page 322; and DE-821, example on page 5-6".

With respect to the rejection over JP '655 and DE '821, distinguishing features of the claimed invention reside in the following:

(1) A graphite-containing heat-resistant cast iron comprises Si and W, and has intermediate layers, in which W and Si are concentrated in the boundaries of graphite particles and a matrix, wherein

(2) the graphite-containing heat-resistant cast iron comprises 3.5-5.6% of Si and 1.2-15% of W on a weight basis, and wherein

(3) a ratio (Xi/Xm) of a weight ratio Xi of W in the intermediate layers to a weight

ratio Xm of W in the matrix is 5 or more and a ratio (Yi/Ym) of a weight ratio Yi of Si in the intermediate layers to a weight ratio Ym of Si in the matrix is 1.5 or more;

(4) the heat-resistant cast iron has a composition comprising, on a weight basis, 1.5-4.5% of C, 3.5-5.6% of Si, 3% or less of Mn, 1.2-15% of W, less than 0.5% of Ni, 0.3% or less of Cr, and 1.0% or less of a graphite-spheroidizing element, the balance being substantially Fe and inevitable impurities, and

(5) the graphite-spheroidizing element comprises 0.003-0.02% by weight of S and 0.05% or less by weight of a rare earth element in addition to 0.005-0.2% by weight of Mg as a graphite-spheroidizing element,

thereby providing a heat-resistant cast iron having better oxidation resistance and thermal crack resistance than those of a conventional high-Si, ferritic spheroidal graphite cast iron, and well-balanced performance such as room-temperature elongation, high-temperature strength, high-temperature yield strength, etc., because of suppressed oxidation and decarburization of graphite and suppressed oxidation of the surrounding matrix regions, so that the heat-resistant cast iron is suitable for parts needing heat resistance, such as exhaust equipment members for automobile engines, etc. (see page 74, lines 3-10 in paragraph [0230] of the specification).

JP '655

In contrast to the claimed invention, JP '655 discloses a cast alloy iron tool comprising being made of a material comprising 3.0-7.0% of C, 5.0% or less of Si, 3.0% or less of Mn, 0.5-40.0% of Ni, 0.5-20.0% of Cr, and one or more of 0.5-30.0% of Cu, 0.1-30.0% of Co, 0.1-10.0% of Mo, 0.1-10.0% of W, 0.05-5.0% of V, 0.01-3.0% of Nb, 0.01-3.0% of Zr and 0.01-3.0% of Ti, the balance being substantially Fe, having a graphite area ratio of 5.0% or more, and a precipitated carbide or carbonitride area ratio of 1.0% or more.

JP '655 thus provides a cast alloy iron tool excellent in seizure resistance and wear resistance for use in tools such as a guide shoe, plug, etc., used for the manufacture of seamless steel pipe (see page 7, lines 1-7 in paragraph [0018] of the specification; English translation of claim 2; page 2, right upper-side column, lines 9-13 of JP '655 attached hereto).

Matrix Structure

With respect to JP '655, it is important to appreciate and note that the structure of the cast alloy iron of JP '655 is converted to a martensite phase structure, an austenite phase structure or a two-phase structure comprising an admixture thereof by alloy elements of Ni, C, Mn, Cr, Mo, Si, etc., which are solidly dissolved in the matrix (see English translation of page 2, left lower-side column, lines 11-18 of JP '655).

The above structure of JP '655 is different from the matrix structure of the claimed invention.

Ni Content

In JP '655, the content of Ni in the cast alloy iron is 0.5-40%, while the content of Ni in the graphite-containing heat-resistant cast iron disclosed in the amended claim 1 of the present application is less than 0.5%.

In JP '655, the Ni content in the cast alloy iron contributes not only to promoting graphitization but also increasing toughness. This effect is recognized when the amount of Ni is 0.5% or more. Further, there is a tendency to disturb graphitization when the Ni content exceeds 40.0%, so that the content of Ni is defined in a range of 0.5-40.0% (see English translation of page 3, right upper-side column, lines 10-14 of JP '655 attached hereto).

In contrast to JP '655, the Ni content in the graphite-containing heat-resistant cast iron of the present application is less than 0.5%. This is because Ni functions to lower the A_{C1}

transformation point of the ferritic cast iron.

When cast iron with a lowered A_{C1} transformation point is used at high temperatures, where heating and cooling are repeated from room temperature to near the A_{C1} transformation point or higher, secondary graphite is precipitated in the matrix, causing an irreversible expansion and high deformation. As a result, the cast iron has decreased thermal crack resistance. The addition of Ni to ferritic cast iron promotes internal oxidation, resulting in decreased oxidation resistance. Because such adverse effects are pronounced when the Ni content is 0.5% or more by weight, Ni is less than 0.5% by weight, preferably 0.3% or less by weight in accordance with the present invention (see page 20, line 28 in paragraph [0085] to page 21, line 9 in paragraph [0086] of the specification).

Cr Content

In the JP '655, the content of Cr in the cast alloy iron is 0.5-20% while the content of Cr in the graphite-containing heat-resistant cast iron in the claimed invention is 0.3% or less by weight

In JP '655, the Cr content of 0.5-20.0% in the cast alloy iron is closely related to the content of C thereof, and the Cr content contributes to achieve wear resistance by forming carbide or carbonitride thereof, which is mainly crystallized during casting, particularly wear resistance is increased at a high temperature. In this regard, it is necessary to obtain a crystallized carbide or carbonitride area ratio of 1.0% or more, and the Cr content in a range of 0.5-20.0% is defined so as to not adversely affect graphitization (see English translation of page 2, right lower-side column, lines 12-15 and page 3, left upper-side column, lines 15-18 of JP '655 attached hereto).

In contrast to JP '655, the Cr content in the graphite-containing heat-resistant cast iron

of the claimed invention is 0.3% or less by weight. This is because Cr functions to lower the A_{C1} transformation point, and to make the ferrite matrix extremely brittle, thereby lowering the room-temperature elongation (see page 21, line 10 in paragraph [0087] and lines 11-12 in paragraph [0088] of the specification).

An exhaust equipment member should have sufficient ductility to avoid cracking and breakage in the exhaust equipment member due to mechanical vibration or due to impact or static load in production processes such as casting, assembling, etc. Further, sufficient ductility should be exhibited during use, not only at high temperatures but also at room temperature. To prevent the A_{C1} transformation point from lowering and the exhaust equipment member from becoming brittle, Cr is preferably controlled to 0.3% or less by weight (see page 21, lines 13-19 in paragraph [0088] and page 65, line 28 to page 66, line 6 in paragraph [0197] of the specification).

Graphite-Spheroidizing Element

Further, the graphite-containing heat-resistant cast iron of the present invention contains 1.0% or less of a graphite-spheroidizing element comprising 0.003-0.02% by weight of S and 0.05% or less by weight of a rare earth element in addition to 0.005-0.2% by weight of Mg as a graphite-spheroidizing element.

Graphite Morphology

Although the morphology of graphite per se is not restricted in the heat-resistant cast iron of the present invention, the graphite is preferably compact vermicular graphite, spheroidal graphite, etc., when higher oxidation resistance is required, or when properties such as room-temperature elongation, high-temperature yield strength, etc., are to be improved. To crystallize compact vermicular and/or spheroidal graphite in an as-cast state, a graphite-

spheroidizing element such as Mg, Ca, rare earth elements, etc., is added in an amount of 1.0% or less by weight (see page 19, line 29 to page 20, line 8 in paragraphs [0081] and [0082] of the specification).

The above discussion establishes that the chemical composition of the graphite-containing heat-resistant cast iron of the present application is different from that of the cast alloy iron of JP '655.

Further, the characteristics of the cast iron obtained by casting and heat-treating and the uses are quite different between the present invention and JP '655.

Examples in JP '655

It should be noted that Example 4 of JP '655 teaches a cast iron alloy composed of, on a weight basis, 3.91% of C, 4.75% of Si, 1.11% of Mn, 2.49% of Ni, 1.52% of Cr, and further 3.76% of Cu, 3.12% of Co, and 2.14% of W. This composition falls outside the composition as claimed in amended claim 1 of less than 0.5% of Ni, and less than 0.3% of Cr; and Example 7 of JP '655 teaches a cast iron alloy composed of, on a weight basis, 6.77% of C, 3.52% of Si, 0.17% of Mn, 12.18% of Ni, 18.25% of Cr, and further 22.32% of Cu, 7.35% of W, and 3.55% of V.

In Examples 4 and 7 of JP '655, although both Examples 4 and 7 meet $Si + (2/7) W \leq 8$, the composition of the respective Examples 4 and 7 does not meet the conditions defined in the amended claim 1 such as less than 0.5% of Ni, 0.3% or less of Cr, and 1.0% or less of a graphite-spheroidizing element.

Accordingly, Applicants submit that the claims the Examiner rejected over JP '655 are not anticipated by JP '655, specifically claim 1 as amended, and, accordingly, claims 1-3, 5, and 7-16 are not anticipated by JP '655.

Withdrawal is requested.

DE '821

DE '821, which corresponds to BP 1 482 724 (BP '724, copy attached), discloses a wear-resistant cast iron alloy with lamellar to nodular deposits (precipitates) containing, on a weight basis, 1.5-4.0% of C, 1.5-6.0% of Si, less than 0.2% of S, less than 2.5% of P, 0-8.0% of Cu, 0-3.5% of Ni and/or Co, 0-2.5% of Sn and/or Sb, 0-5 0% of Mo, 0-5 0% of W, 0-3.0% of Mn, 0-3.0% of Cr, 0-10% of V, 0-2.0% of Ti, 0-5.0% of Nb and/or Ta, 0-20% of Al and the rest iron (see Abstract and claim 1 of DE '821 attached to the Action).

Differences in Basic Structure

The cast alloys of DE-821 have a bainitic to a martensitic basic structure (see page 2, left-side column, lines 41-42 of BP '724, or page 5, the 2nd paragraph, lines 1-2 of DE '821).

The above structure of DE-821 is different from the matrix structure of the claimed invention.

Graphite-Spheroidizing Element

DE '821 thus does not contain at least the graphite-spheroidizing element Mg, though DE-821 teaches a wear-resistant cast iron alloy with lamellar to nodular deposits of the graphite as well as point-form to sphere deposits (precipitates) of carbide (see page 2, left-side column, lines 41-45 of BP '724, or page 5, the 2nd paragraph, lines 2-4 of DE '821), and DE '821 contains no disclosure or suggestion of any concept which relates to a graphite-spheroidizing element (see page 2, left-side column, lines 26-45 of BP '724, or the paragraph bridging pages 4 and 5 and page 5, the 1st paragraph of DE '821).

Specifically, DE '821 discloses on pages 5-6 thereof one Example of a wear-resistant cast iron alloy containing, on a weight basis, 2.2% of C, 3.9% of Si, 0.9% of P, 0.08% of S, 14%

of Cu, 0.6% of Ni, 0.2% of Sn, 1.5% of Mo, 3.4% of W, 0.9% of Mn, 0.4% of Cr, 1.5% of V, 0.2% of Ti, 0.7% of Nb, 0.01% of B, 0.22% of Al (see also, page 2, left-side column, line 52 to right-side column line 71 of BP '724, where "and the rest iron" is added after "0.22% by weight aluminum").

Although the Examiner states that the above sample satisfies the claimed equation Si + (2/7)W $\leq$ 8, a careful comparison of the above sample and the claimed equation shows that the essential feature of the claimed equation involves 0.9% of P, 0.6% of Ni, 0.4% of Cr, 1.5% of V and 0.22% of Al without 0.005-0.2% by weight of Mg as a graphite-spheroidizing element. These values fall outside the corresponding values defined in the amended claim 1 of the present application (with respect to the content of Mo, V, Ti, B and Al, see page 23, line 17 in paragraph [0099] to page 25, line 5 in paragraph [0113] of the specification). Also, the graphite-containing heat-resistant cast iron of the present invention does not have the element P contained in the example above of DE '821.

Further, with respect to the Example of DE '821 above discussed, although it meets Si + (2/7) W $\leq$ 8, the composition of DE '821 does not meet the values defined in amended claim 1 such as less than 0.5% of Ni, 0.3% or less of Cr, and 1.0% or less of a graphite-spheroidizing element.

As is clear from the foregoing, the chemical composition of the graphite-containing heat-resistant cast iron of the present application is different from that of the cast alloy iron of DE '821.

Applicants thus respectfully submit that one of ordinary skill in the art referring to DE '821 would not find claims 1-3, 5 and 17-16 anticipated, specifically would not find claim 1 anticipated nor rendered obvious, and request withdrawal of the rejection over DE '821.

Differences in Composition Lead to Differences in Properties

In Paragraph 5 of the Action the Examiner states:

"Also since prior art examples meet the claimed composition, then the properties (e. g. Xi/Xm, Yi/Ym, W carbide particles on surface graphite, A_{C1} temperature, oxidation loss, thermal cracking life) as recited by one or more of the depending claims would be expected in absence of proof to the contrary".

Applicants respectfully submit that the above analysis is flawed since neither JP '655 or DE '821 teach the chemical composition of the graphite-containing heat-resistant cast iron of the present application as explained above. As a consequence, the properties referred to (e. g. Xi/Xm, Yi/Ym, W carbide particles on surface graphite, A_{C1} temperature, oxidation loss, thermal cracking life) would not be expected from of JP '655 and DE '821.

Applicants would, however, like to offer some additional discussion on the properties of the graphite-containing heat-resistant cast iron of the present invention.

The heat-resistant cast iron of the present invention, as shown in Fig. 1, has intermediate layers 12, in which W and Si are concentrated, in the boundaries of graphite particles 11 and the matrix 13. The intermediate layers 12 act as protective layers (barriers) to prevent oxidizing gas from entering the graphite particles 11 and to prevent the diffusion of C from the graphite particles 11. This improves the oxidation resistance and thus the thermal crack resistance of the heat-resistant cast iron. The intermediate layers 12, in which W and Si are concentrated, are formed during a solidification process in casting, though it is believed that they are also formed in a heat treatment step and/or during use at high temperatures. W and Si are believed to be concentrated in the intermediate layers 12 in the boundaries of the graphite particles 11 and the matrix 13, because of a stable energy state which exists, which will result in intermediate layers

12 being formed in the boundaries of the graphite particles 11 and the matrix 13 (see full paragraph [0063] at pages 15-16 and Fig 1 of the specification).

With respect the properties of Xi/Xm and Yi/Ym, in the heat-resistant cast iron of the present invention, the ratio (Xi/Xm) of the weight ratio Xi of W in the intermediate layers 12 to the weight ratio Xm of W in the matrix 13 (measured at an arbitrary position by FE-TEM-EDS-energy-dispersive X-ray spectroscopy) is desirably 5 or more. This value indicates that W when concentrated 5 times or more can effectively prevent the entrance of oxidizing gases and the diffusion of C (see full paragraph [0115] at page 25 and Fig. 1 of the specification). The ratio (Yi/Ym) of the weight ratio Yi of Si in the intermediate layers 12 to the weight ratio Ym of Si in the matrix 13 (both measured at an arbitrary position by FE-TEM-EDS) is desirably 1.5 or more. This value indicates that Si concentrated 1.5 times or more can effectively prevent entrance of oxidizing gases and the diffusion of C (see full paragraph [0116] at page 25 and Fig. 1 of the specification).

Neither of JP '655 or DE '821 teaches or suggests as essential features that the intermediate layers 12 act as protective layers (barriers) to prevent oxidizing gas from entering the graphite particles 11 and the diffusion of C from the graphite particles 11, thereby improving oxidation resistance and thermal crack resistance of the heat-resistant cast iron, as shown Fig. 1. As a consequence, it is seen that the properties Xi/Xm and Yi/Ym are indispensable aspects of the presently claimed invention, neither taught nor suggested in JP '655 or DE '821.

With respect to the number of graphite particles having W-containing carbide particles in the boundaries with the matrix, carbide particles in the boundaries of graphite particles and the matrix are observed by FE-SEM, EDS (10,000 times) to analyze the components of carbide

on the graphite surface. Such analysis has shown that W is contained in carbide particles in the boundaries of graphite particles and the matrix (carbide on the graphite surface), as shown in Fig. 11(a), where a great number of W-containing carbide particles 114 are formed on the graphite 111 (see full paragraph [0162] at page 48 and Fig. 11(a) of the specification) and granular W-containing carbide particles 114 appear to be white on the surface of the graphite 111 in Fig 11(b) (see paragraphs [0164][0166] at pages 48-49 and Fig 11(b) of the specification).

In more detail, the number of graphite particles having W-containing carbide particles substantially in their boundaries with the matrix is preferably 75% or more of the total number of graphite particles (as claimed in claim 12). This suppresses the permeation of oxidizing gases and the diffusion of C, thereby improving oxidation resistance and thermal crack resistance of the heat-resistant cast iron. The W-containing carbide particles appear to be precipitated during a solidification process in casting, and in a heat treatment step and/or during high-temperature use. The W-containing carbide particles appear to be formed substantially in the graphite-matrix boundaries because of the existence of a stable energy state (see page 25, line 23 to page 26, line 2 in paragraph [0117] of the specification).

The larger number and area ratio of W-containing carbide particles present in the boundaries of the graphite particles and the matrix provide greater effects of suppressing the entrance of oxidizing gases and the diffusion of C. Specifically, in the boundaries of graphite particles and the matrix, the number of W-containing carbide particles on graphite particles, which is represented by the number of W-containing carbide particles on the graphite particles exposed by etching, is preferably 3 x $10^5/mm^2$ or more per a unit area of graphite. Further, the area ratio of W-containing carbide particles, which is determined on the graphite particles

exposed by etching, is preferably 1.8% or more as claimed in the amended claim 13 (see page 26, lines 3-11 in paragraph [0118] of the specification).

Against the above background, neither JP '655 or DE '821 teaches or suggests the presence of a great number of W-containing carbide particles 114 formed on the surface of the graphite 111 as shown in Figs 1, 1(a) and 11(b) of the present specification.

With respect to the "A_{C1} temperature", a property which is mentioned in the Action as stated above, the term "A_{C1} transformation point" in claim 14 means the ferrite-austenite transformation temperature at which the matrix structure changes from a ferrite/pearlite phase to an austenite phase. A conventional high-Si, ferritic spheroidal graphite cast iron has an A_{C1} transformation point as low as about 800°C. Since the austenite has a larger linear expansion coefficient than the ferrite, when part of an exhaust equipment member reaches about 800°C or higher, i.e., higher than the A_{C1} transformation point, the matrix changes to an austenite phase and drastically expands, resulting in strain due to the expansion ratio difference (see page 4, lines 11-18 in paragraph [0009] of the specification).

Although a high-Si, ferritic spheroidal graphite cast iron containing about 4% of Si has a higher A_{C1} transformation point (and thus higher oxidation resistance than those of conventional spheroidal graphite cast irons), it exhibits insufficient oxidation resistance and thermal crack resistance when heated to 800°C (the A_{C1} transformation point) or higher, resulting in a short life (see page 5, lines 12-16 in paragraph [0010] of the specification).

As a consequence, in accordance with the presently claimed invention, because Ni functions to lower the A_{C1} transformation point of the ferritic cast iron, the Ni content in the graphite-containing heat-resistant cast iron is less than 0.5%. Further, because Cr functions to lower the A_{C1}, transformation point, and make the ferrite matrix extremely brittle, thereby

lowering room-temperature elongation, the Cr content in the graphite-containing heat-resistant cast iron is 0.3% or less by weight.

In distinction to the above, the Examiner is requested to note that Example 4 of JP '655 teaches 2.49% of Ni and 1.52% of Cr, Example 7 of JP '655 teaches 12.18% of Ni and 18.25% of Cr, and one Example of DE '821 teaches 0.4% of Cr and 0.6% of Ni, respectively. These Ni contents and Cr contents are outside less than 0.5% of Ni and 0.3% or less of Cr of the claimed invention. Thus, it can be said that insofar as these teachings are concerned, they represent a teaching **against** the present invention.

Applicants respectfully submit that the above discussion establishes that contrary to the present invention, neither JP '655 or DE '821 pays any attention whatsoever to the A_{C1} transformation point of cast iron alloys.

With respect to the "oxidation loss" property maintained in the Action above, in the present application, the term "weight loss by oxidation" is expressed by the weight loss of the heat-resistant cast iron upon oxidation kept at 800°C for 200 hours in the air (see page 11, lines 8-9 in paragraph [0031] of the specification). This weight loss by oxidation is preferably 60 mg/cm^2 or less as claimed in claim 15.

The weight loss by oxidation above is closely related to the A_{C1} transformation point of 840°C or higher when measured from 30°C as room temperature at a temperature-elevating speed of 3°C/minute. Since a heat-resistant cast iron having an A_{C1} transformation point of 840°C or higher has excellent oxidation resistance and thermal crack resistance, it exhibits high durability and long life when used for exhaust equipment members subjected to repetition of heating and cooling from room temperature to temperatures exceeding 800°C by an exhaust gas (see page 26, line 24 to page 27, line 4 in paragraph [0119] of the specification).

Specifically, if the weight loss by oxidation of the cast iron exceeds 60 mg/cm^2 in the air at 800°C for 200 hours, when the cast iron is heated to 800°C, a large number of oxide layers, from which cracking occurs, are formed, resulting in insufficient oxidation resistance. If the weight loss by oxidation is 60 mg/cm^2 or less at 800°C for 200 hours in the air, the formation of oxide layers and cracks is suppressed, resulting in a heat-resistant cast iron with excellent oxidation resistance and thermal crack resistance, high heat resistance and durability, and long life (see page 27, lines 12-20 in paragraph [0120] of the specification).

To achieve a weight loss by oxidation of 60 mg/cm^2 or less at 800°C for 200 hours in the air, the Ni content is preferably less than 0.5% by weight (see page 57, lines 24-25 in paragraph [0180] of the specification), rare earth elements are preferably present in an amount of 0.05% or less by weight, and S is preferably present in an amount of 0.003-0.02% by weight (see page 58, lines 10-11 in paragraph [0181] of the specification).

Against the above background, it can be seen that neither JP '655 or DE '821 teach or suggest any weight loss by oxidation of cast iron alloys kept at 800°C for 200 hours in the air, and that such a weight loss by oxidation should preferably be 60 mg/cm^2 or less.

With respect to the "thermal cracking life" property mentioned in the Action as described above, in the present application the term "thermal cracking life" is expressed by the thermal cracking life of 780 cycles or more in a thermal fatigue test, in which heating and cooling are conducted under the conditions of an upper-limit temperature of 840°C, a temperature amplitude of 690°C and a constraint ratio of 0.25 (see claim 16; page 28, lines 18-21 in paragraph [0122] of the specification).

In more detail, an exhaust equipment member is required to have a long thermal cracking life in the repetition of the operation (heating) and stopping (cooling) of an engine The thermal

cracking life is one measure representing how high the heat resistance is. The thermal cracking life is expressed by the number of heating/cooling cycles until cracking causes thermal fatigue fracture in a thermal fatigue test. An exhaust equipment member is exposed to an exhaust gas at 700°C or higher, particularly near 900°C, and the temperature of the exhaust equipment member can reach 800°C or higher. If the thermal cracking life were less than 780 cycles under the above conditions, the cast iron would not have enough life until thermal fatigue fracture occurs in use as an exhaust equipment member. Long-life, heat-resistant parts such as exhaust equipment members, etc., are formed by the heat-resistant cast iron of the present invention having a thermal cracking life of 780 cycles or more (see page 28, line 22 to page 29, line 5 in paragraph [0122] of the specification).

As shown in Table 5 at pages 61-63 in paragraphs [0188]-[0190] of the specification, in the heat-resistant cast iron having a thermal cracking life of 780 cycles or more, the Cr content is preferably 0.3% or less by weight, and the Cu content is preferably 6.5% or less by weight (see paragraphs [0197] and [0199] of the specification).

Examples 4 and 7 of JP '655 do not meet the limits on the Cr and Cu contents and one Example of DE '821 as discussed above does not meet the limits on the Cr content.

Applicants thus submit, in addition to traversing remarks presented at other points, that one of ordinary skill in the art referring to JP '655 or DE '821, alone or in combination, would not find the properties recited in claims 12-16 to be suggested in any fashion, and thus claims 12-16 are not anticipated or obvious over JP '655 or DE '821.

Rejection of claims 4, 5, 6 and 17 to 25 under 35 U.S.C. § 103 (a) over JP '655 alone or in view of admitted prior art in paragraph [0003] of Applicant's specification set forth in Paragraphs 7-13 of the Office Action.

Claims 4-6, 20 and 22 have been canceled, mooting the rejection of these claims.

Claim 17 of the present application calls for that "An exhaust equipment member made of the heat-resistant cast iron recited in claim 1".

As earlier discussed in this AMENDMENT...1.111, Applicants believe they have established that claim 1, as amended, is not anticipated or obvious over JP '655.

Although in paragraph [0003] of the present application it is indicated that:

"(Accordingly,) exhaust equipment members sometimes become higher than 800°C, so that higher heat resistance such as oxidation resistance, thermal crack resistance, etc. is required for the exhaust equipment members. Various improvements of the high-temperature properties of spheroidal graphite cast irons have thus been investigated," the specification of the present application contains the following teaching regarding JP61-157655A in paragraph [0018] thereof:

"The wear resistance of this cast alloy iron is mainly provided by hard Cr carbide or carbonitride particles crystallized during casting. However, because the Cr carbide lowers toughness and ductility, this cast alloy iron does not have toughness and ductility necessary for the exhaust equipment members. In addition, because hard carbide or carbonitride particles lower the machinability, the cast alloy iron has low machining efficiency, resulting in increased production costs and thus expensive exhaust equipment members. Further, because it contains as much Ni as 0.5-40.0%, the ferrite-based east iron (ferritic cast iron) has low A_{C1} transformation point and oxidation resistance, failing to achieve sufficient durability and life when used in environments higher than 800°C. Accordingly, heat-resistant cast irons suitable for exhaust equipment members used in environments higher than 800°C cannot be conceived of from the cast tool described in JP61-1 57655A."

Considering the above total teaching, Applicants respectfully submit that what the Examiner characterizes as "admitted prior art" in paragraph [0003] of the specification would not suggest to one of ordinary skill in the art in light of JP '655 the subject matter of claim 17, and thus claim 17 is unobvious over JP '655 alone or in view of the above-admitted prior art.

As claim 18 depends from claim 17, it is also submitted to be unobvious over the above combination of references.

As amended claim 19 is dependent from the amended claim 1, it is submitted to be patentable over JP '655 alone or in view of the admitted prior art in paragraph [0003] of the specification for the same reasons as discussed above in claim 17.

With respect to claims 21 and 23-25, Applicants submit they are patentable for the same reasons as amended claim 19 (they depend from amended claim 19).

Rejection to claims 4 to 6 and 17 to 25 under 35 U.S.C. § 103 (a) as being unpatentable over DE '821 alone or in view of JP '655 and further in view of admitted prior art in paragraph [0003] of the specification set forth in Paragraphs 14-18 of the Office Action.

Claims 4-6, 20 and 22 have been canceled mooting the rejections of these claims.

Claim 17 of the present application calls for: "An exhaust equipment member made of the heat-resistant cast iron recited in claim 1".

Applicants believe it has earlier been established that amended claim 1 is not obvious over DE '821 or JP '655.

Applicants thus respectfully submit that one of ordinary skill in the art referring to DE '821 alone or in view of JP '655 further in view of the admitted prior art above-referenced would not find the subject matter of the rejected claims to be obvious for the reasons discussed

regarding the rejection of claims 4, 5, 6 and 17-25 as obvious over JP '655 alone or in view of the admitted prior art, and request withdrawal.

Applicants submit that since amended claim 1 is not obvious over the above references, claim 17 is not obvious.

They further submit claim 18 is unobvious in view of its dependency from claim 1.

With respect to claims 21 and 23-25, they submit the same to be unobvious in view of their dependency from claim 19.

Withdrawal of all rejections and allowance is requested.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

Peter D. Olexy
Registration No. 24,513

SUGHRUE MION, PLLC
Telephone: (202) 293-7060
Facsimile: (202) 293-7860

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